

Appn. No. 09/525,477
Amendment dated September 4, 2003
Reply to Office Action of March 17, 2003

LISTING OF CLAIMS:

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1. (Currently Amended) An ink jet recording device comprising:
 - a body;
 - a carriage movable relative to the body,
 - an ink jet recording head provided to said carriage, and
 - an ink supply device mounted to said carriage for supplying ink to said recording head, wherein said ink supply device is constructed as a differential pressure valve including a coil spring, a valve seat and a movable membrane normally contacted elastically with said valve seat by said coil spring;
 - wherein said valve seat obstructs the flow of ink and only allows ink to flow around the valve seat when the movable membrane is disengaged ~~with~~ ~~from~~ the valve seat; and
 - wherein said movable membrane is located between the coil spring is located opposite ~~and~~ the valve seat ~~with respect to the movable membrane and the coil spring opposes the valve seat.~~

2. (Previously Presented) The ink jet recording device according to Claim 1, wherein:

 said ink supply device is mountable to said carriage and provided with an ink storage area.

3. (Original) An ink-jet recording device according to Claim 1, wherein:
 - said movable membrane is arranged in parallel to a plane perpendicular to a direction in which said carriage is moved.

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wherein:

4. (Previously Presented) The ink jet recording device according to Claim 2,

said movable membrane is arranged in parallel to a plane perpendicular to a direction in which said carriage is moved; and

a plurality of ink supply devices are mounted to said carriage and arranged adjacent to one another in the direction in which said carriage is moved.

5. (Withdrawn) An ink-jet recording device according to claim 1, wherein:

said movable membrane is arranged in parallel to a vertical plane parallel to a direction in which said carriage is moved.

6. (Previously Presented) The ink jet recording device according to Claim 2,

wherein:

a main tank having ink is installed on the body; and

a conduit adapted between said main tank and said ink supply device conveys ink from said main tank to said ink supply device.

7-10. (Cancelled).

11. (Previously Presented) The ink jet recording device according to Claim 2,

wherein:

said ink supply device is provided with an ink injection port; and

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an ink supplementing device is provided within a range where said carriage is moved and in a non-printing area, said ink supplementing device being detachably contacted with said ink injection port for injecting ink.

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12. (Currently Amended) An ink supply unit, comprising:
a differential pressure valve including a coil spring and a movable membrane normally contacted elastically with a valve seat by said coil spring, is accommodated in a container having an ink storage chamber and an ink supply port;
wherein the ink storage chamber communicates with the ink supply port;
wherein the ink supply port is adapted to be connected to an ink jet recording head;
wherein said valve seat obstructs the flow of ink and only allows ink to flow around the valve seat when the movable membrane is disengaged withfrom the valve seat; and
wherein said movable membrer is located between the coil spring is located oppositeand the valve seat with respect to the movable membraneand the coil spring opposes the valve seat.

13. (Original) An ink supply unit according to Claim 12, wherein:
said movable membrane is arranged vertically when said ink supply unit is mounted to a carriage.

14. (Original) An ink supply unit according to Claim 13, wherein:
said movable membrane is arranged in parallel to a plane perpendicular to a direction in which said carriage is moved.

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15. (Withdrawn) An ink supply unit according to Claim 13, wherein:
said movable membrane is arranged in parallel to a direction in which said
carriage is moved and in parallel to a vertical plane.

16. (Previously Presented) An ink supply unit, comprising:
a differential pressure valve including a coil spring and a movable membrane
normally contacted elastically with a valve seat by said coil spring is accommodated in a
container having an ink storage chamber and an ink supply port;
wherein the ink storage chamber communicates with the ink supply port; wherein
the ink supply port is adapted to be connected to an ink jet recording head;
wherein said movable membrane is a disc-like elastic membrane formed at a
center of said differential pressure valve with an ink flow port;
wherein said valve seat is located on an upstream side of ink flow and facing said
ink flow port; and
wherein said coil spring is located on a downstream side and pressing said ink
flow port of said movable membrane onto said valve seat.

17. (Previously Presented) The ink supply unit according to Claim 12, wherein: a
spring holder is disposed between said coil spring and said movable member; and
wherein said movable membrane receives pressure of said coil spring via the
spring holder.

18. (Previously Presented) The ink supply unit according to Claim 12, wherein:

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said container includes a frame-like casing provided at its side surface with a window, and an air intercepting film sealing said window.

19. (Original) An ink supply unit according to Claim 12, wherein:

said ink storage chamber communicates with an ambient air via a capillary formed in said container.

20. (Original) An ink supply unit according to Claim 19, wherein:

said capillary includes a groove formed on an upper wall of said ink storage chamber, and an air intercepting film sealing said groove.

21. (Original) An ink supply unit according to Claim 19, wherein:

said capillary includes a groove formed on a side wall of said ink storage chamber, and an air intercepting film sealing said groove.

22. (Previously Presented) An ink supply unit according to Claim 12, wherein:

said movable membrane includes a movable part made of soft material, and a fixing part made of hard material and fixed to a periphery of said movable part.

23. (Original) An ink supply unit according to Claim 22, wherein:

a supporting part is formed in an outer periphery of said movable part; and said movable part is connected to said fixing part via said supporting part.

24. (Original) An ink supply unit according to Claim 12, wherein:

a movable part is provided to said movable membrane; and

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a supporting part is formed in an outer periphery of said movable part.

25. (Previously Presented) The ink supply unit according to Claim 12, wherein:
said movable membrane is provided with a movable part; and
an annular bent part is formed in the vicinity of an outer periphery of said
movable part.

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26. (Original) An ink supply unit according to claim 24, wherein:
said movable part is located approximately at a center in a thickness direction of
said supporting part.

27. (Original) An ink supply unit according to Claim 22 or 24, wherein:
a central area of said movable part is offset from a peripheral area thereof.

28. (Original) An ink supply unit according to Claim 22, wherein:
said fixing part is formed, at its side to said valve seat, with a flange part; and
a position of said movable part in its thickness direction is regulated by said
flange part.

29-37. (Cancelled).

38. (Original) An ink supply unit according to Claim 12, wherein:
an ink injection port is provided to an upper surface of said container, and
communicated with a bottom part of said ink storage chamber via a passage isolated from said
ink storage chamber.

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39. (Original) An ink supply unit according to Claim 12, wherein:
an ink injection port is provided to an upper surface of said container, and
communicated with a bottom part of said ink storage chamber in the vicinity of an upstream side
of said differential pressure valve via a passage isolated from said ink storage chamber.

40-45. (Cancelled).

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46. (Previously Presented) The ink supply unit according to Claim 19, wherein:
a film member having both gas permeability and ink repellent properties is
interposed between said capillary and said ink storage chamber.

47-57. (Cancelled).

58. (Original) An ink tank unit for an ink jet recording apparatus, comprising:
a container defining an ink chamber for accumulating ink therein, and an ink
supply passage to be communicated with a recording head; and
a negative pressure generating mechanism selectively communicating said ink
chamber with said ink supply passage depending on pressure change caused in said ink supply
passage due to ejection of ink from the recording head, said mechanism including:
a stationary valve part;
a movable valve part having an elastically deformable membrane having a
through hole; and
a biasing spring by which said stationary valve part and said movable valve part
are biased against each other to normally close said through hole, said biasing spring permitting

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selective separation of said movable valve part from said stationary valve part to open said through hole and communicate said ink chamber with said ink supply passage through said through hole depending on said pressure change.

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59. (Original) An ink tank unit for an ink jet recording apparatus, comprising:
a container having a partition wall that defines and separates first and second ink accumulating chambers, said partition wall having a first ink passage;
an elastically deformable first valve part opposite from said first ink accumulating chamber with respect to said partition wall, and defining a third ink accumulating chamber between said first valve part and said partition wall and within said second ink accumulating chamber, said first valve part having a second ink passage that is opened to said third ink accumulating chamber at a first location offset from a second location where said first ink passage is opened to said third ink accumulating chamber;
a stationary, rigid second valve part provided to said partition wall and aligned with said first location,
wherein said first and second valve parts cooperatively opens and closes said second ink passage by contact with each other with the aid of a spring biasing said elastically deformable first valve part to said stationary, rigid second valve part, thereby selectively communicating first, second and third chambers together through said first and second passages.

60. (Previously Presented) The ink supply unit according to Claim 22, wherein: an annular bent part is formed in the vicinity of an outer periphery of said movable part.

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61. (Previously Presented) The ink supply unit according to Claim 24, wherein: an annular bent part is formed in the vicinity of an outer periphery of said movable part.

62. (Currently Amended) The ink jet recording device of claim 1, wherein said movable membrane is disposed between said valve seat and said coil spring, and wherein said coil spring urges said movable membrane against said valve seat.

63. (Previously Presented) The ink jet recording device of claim 1, wherein said valve seat is fixed with respect to said ink supply device.

64. (Currently Amended) The ink supply unit of claim 12, wherein said movable membrane is disposed between said valve seat and said coil spring, and wherein said coil spring urges said movable membrane against said valve seat.

65. (Previously Presented) The ink supply unit of claim 12, wherein said valve seat is fixed with respect to said ink supply device.

66. (Withdrawn) An ink jet printing cartridge comprising:
n ink storage chambers wherein at least one of the n ink storage chambers is located substantially below another one of the n ink storage chamber, wherein n is greater than 1; an ink supply port; and

a negative pressure valve disposed between said n ink storage chambers and the ink supply port and controls ink flow to said ink supply port from said n ink storage chambers; wherein at least one of said n ink storage chambers has an outlet passage located in a lower portion of said at least one n ink storage chamber;

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wherein ink stored in the n ink storage chambers is depleted sequentially beginning with the first ink storage chamber and ending with said n^{th} ink storage chamber.

67. (Withdrawn) The ink jet printing cartridge of claim 66, wherein said ink flows sequentially from said first ink storage chamber to said n^{th} ink storage chamber; and wherein in said ink flows from said n^{th} ink storage chamber to said negative pressure valve.

68. (Withdrawn) The ink jet printing cartridge of claim 66, wherein said ink flows from an ink storage chamber which is lower than said negative pressure valve.

69. (Withdrawn) The ink jet printing cartridge of claim 66, wherein said negative pressure valve further comprises a movable membrane normally contacted elastically with a valve seat by a coil spring.

70. (Withdrawn) The ink jet printing cartridge of claim 69, wherein said movable membrane is disposed between said valve seat and said coil spring; and wherein said coil spring urges said movable membrane against said valve seat.

71. (Withdrawn) The ink jet printing cartridge of claim 66, wherein a filter is disposed between an upper ink storage chamber and the negative pressure valve.

72. (Previously Presented) An ink jet recording device comprising:
a body;
a carriage movable relative to the body;

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an ink jet recording head provided to said carriage, and
an ink supply device mounted to said carriage for supplying ink to said recording
head, wherein said ink supply device is constructed as a differential pressure valve including a
coil spring, a valve seat and a movable membrane normally contacted elastically with said valve
seat by said coil spring;

wherein said valve seat obstructs the flow of ink and only allows ink to flow
around the valve seat when the movable membrane is disengaged with the valve seat; and
wherein the valve seat is stationary.

Claim 1:
73. (Previously Presented) An ink supply unit, comprising:
a differential pressure valve including a coil spring and a movable membrane
normally contacted elastically with a valve seat by said coil spring, is accommodated in a
container having an ink storage chamber and an ink supply port; wherein the ink storage
chamber communicates with the ink supply port; wherein the ink supply port is adapted to be
connected to an ink jet recording head;

wherein said valve seat obstructs the flow of ink and only allows ink to flow
around the valve seat when the movable membrane is disengaged with the valve seat; and
wherein the valve seat is stationary.

74. (Withdrawn) An ink jet recording device according to Claim 1, wherein:
a main tank is mountable to said carriage, and adapted to be attached to and
detached from said ink supply means.

75. (Withdrawn) An ink jet recording device according to Claim 1, wherein:

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a main tank is provided with a connection port; and said container is provided with a hollow member insertable into said connection port with a fluid-tight state maintained.

76. (Cancelled).

77. (Cancelled).

78. (Previously Presented) An ink supply unit according to Claim 12, wherein: a filter is arranged in an upstream side with respect to said differential pressure valve.

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79. (Previously Presented) An ink supply unit according to Claim 12, wherein: said coil spring is contacted with said movable membrane via a holder having an ink flow hole located to face an ink flow port of said movable membrane.

80. (Previously Presented) An ink supply unit according to Claim 12, wherein: said valve seat is formed as a spherical surface protruded toward said movable membrane.

81. (Previously Presented) An ink supply unit according to Claim 12, wherein: a protruded part is formed on a surface of said valve seat where it is contacted with said valve seat.

82. (Previously Presented) An ink supply unit according to Claim 12, wherein: said valve seat is formed as a protruded part having a planar surface on a side toward said movable valve.

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83. (Previously Presented) An ink supply unit according to Claim 12, wherein:
said movable valve includes a disc-like movable part made of soft high polymer
material and provided at its outer periphery with a thick part, and an annular supporting part made
of hard high polymer material and provided at its valve seat side with a flange part; and
said valve seat is formed as a protruded part defining a planar surface on a
movable valve side and having a thickness approximately equal to that of said flange part.

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84. (Cancelled).

85. (Withdrawn) An ink supply unit according to Claim 12, wherein:
said differential pressure valve includes a disc-like movable membrane formed at
its center with an ink flow port, a coil spring contacted with said movable membrane, and a valve
seat formed as a protruded part defining a planar surface on a movable membrane side and
having an outer edge located outside an outer periphery of said coil spring.

86. (Cancelled).

87. (Withdrawn) An ink supply unit according to Claim 12, wherein:
said ink storeroom and an area where said differential pressure valve is
accommodated are separated by a wall provided at its bottom part with a communicating hole;
a plurality of electrodes for detecting an ink level are provided in said ink storage
chamber; and

at least one of said electrodes is disposed above said communicating hole.

88. (Withdrawn) An ink supply unit according to Claim 12, wherein:

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said differential pressure valve includes a spherical movable membrane provided at its center with an ink flow port, a coil spring contacted with said movable membrane, and a valve seat having a spherical part protruded toward said movable membrane.

89-92. (Cancelled).

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93. (Withdrawn) An ink supply unit according to Claim 12, wherein:
ink level detecting means is arranged in an upstream side with respect to said differential pressure valve.

94. (Cancelled).

95. (Cancelled).

96. (Withdrawn) An ink jet recording device comprising an ink jet recording head provided to a carriage, ink supply means, mounted to said carriage, for supplying ink to said recording head, and ink supplementing means for supplementing ink to said ink supply means, wherein:

said ink supply means is partitioned into an ink storage chamber and a valve chamber by a wall provided at its bottom part with an ink inflow port;

an ink injection port and an air open port connectable to an exterior are provided to said ink storage chamber;

a differential pressure valve opened when pressure in a recording head side is decreased is accommodated in said valve chamber;

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said supplementing means is formed as negative pressure generating means for supplying negative pressure to said air open port; and

negative pressure in said ink supplementing means acts on said ink storage chamber to cause ink to flow from said ink cartridge to the bottom part of said ink storage chamber when ink is supplied to said ink supply means.

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97-99. (Cancelled).

100. (Withdrawn) An ink jet recording device comprising an ink jet recording head provided to a carriage, ink supply means, mounted on said carriage, for supplying ink to said recording head, ink supplementing means for supplementing ink to said ink supply means, and capping means sealing said recording head and receiving negative pressure from a suction pump, wherein:

said ink supply means is partitioned by a wall provided at its bottom part with an ink inflow port into an ink storage chamber and a valve chamber that accommodates a differential pressure valve opened when pressure in a recording head side is decreased;

said ink supply means is provided with an ink injection port communicating with the bottom part of said ink storage chamber in the vicinity of an upstream side of said differential pressure valve via a passage isolated from said ink storage chamber; and

negative pressure is applied to said recording head via said capping means in a state in which said ink injection port is connected to an ink cartridge accommodating degassed ink so that ink in said valve chamber is replaced with degassed ink while discharging ink from said recording head.

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101. (Withdrawn) An ink-jet recording device comprising an ink jet recording head provided to a carriage, ink supply means, mounted on said carriage, for supplying ink to said recording head, and an ink tank for supplying ink to said ink supply means, wherein said ink supply means accommodates an ink storage chamber, an air communicating hole communicating said ink storage chamber with an ambient air, and a differential pressure valve opened where pressure on a recording head side is decreased; and said ink tank communicates with the ambient air via said air communicating hole provided to said ink supply means.

102-103. (Cancelled).